

Gnu, I left Msongozi's on the Loangwa R. and struck down the valley with the object of making Kambombo's. But I had only gone one day's journey to Mwan-kanka, when we were fired on by a colony of slave-traders settled there under a half-bred Arab, and further progress was quite out of the question."

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Mr. R. E. Holding exhibited and made remarks on a fine shed antler of the Circassian Red Deer (*Cervus maral*), which had been shipped with a cargo of bones and horns from Tiflis, on the Black Sea. The antler had 9 well-developed points, weight 9 lbs. 2 oz., its length of beam 41 inches, length of brow-tine 18 inches.

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Mr. Holding also exhibited, on behalf of W. Burton, Esq., F.Z.S., an abnormal pair of horns of the Wild Goat from the Caucasus, having a curious inward spiral form (see figure).



Abnormal horns of Wild Goat  
from the Caucasus.

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The following papers were read :—

1. A Contribution to the Anatomy of the Hoatzin (*Opisthocomus cristatus*). By P. CHALMERS MITCHELL, M.A., F.Z.S.

[Received June 2, 1896.]

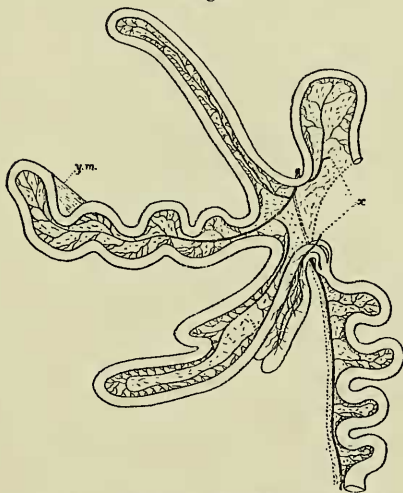
The material upon which this communication is based consists of several specimens of the Hoatzin, preserved in spirit, and kindly given me by Mr. F. V. McConnel, whom my friend Mr. F. W. Headley told that they would be of service to me. I am indebted to the Society and to its Prosector for the continued use of the

laboratory at the Gardens in the course of my investigations into the anatomy of birds. A number of important memoirs have appeared upon the Hoatzin, but, in the present condition of our knowledge of the relations among the groups of birds, additional details concerning the structure of a type so aberrant may prove useful.

*Alimentary Canal.*

The extraordinary crop and the general characters of the gizzard and intestines have been sufficiently described by L'Herminier<sup>1</sup> and Gadow<sup>2</sup>. Following the method which I have described in a former paper<sup>3</sup>, I dissected out the coils of the intestine and the

Fig. 1.



Intestinal convolutions of *Opisthocomus cristatus*.

x, bridging-vessel divided; y.m., mesentery of the yolk-sac vestige.

great veins in a well-grown chick and in three adults. As shown in figure 1, the duodenal loop is unusually short and wide, and is much less specialized than in most other birds I have examined.

<sup>1</sup> "Recherches anatomiques sur quelques genres d'oiseaux rares ou peu connus," Ann. Sci. Nat. sér. 2, Zoologie, viii. Paris, 1837.

<sup>2</sup> "On the Taxonomic Value of the Intestinal Convolutions in Birds," P. Z. S. 1889, p. 303.

<sup>3</sup> "On the Intestinal Tracts of Birds," P. Z. S. 1896, p. 136.

The mid-gut is thrown into three well-marked loops: the first of these is long and narrow; the second is long, is much more open, and shows a tendency to be thrown into a very rough spiral. In the chick and in two adults I found no trace of the yolk-sac diverticulum, but its place of attachment was marked by a distinct and strong remnant of the ventral mesentery; in a third adult, as shown in the figure, this mesentery ran to a minute vestige of the yolk-sac, placed nearly at the summit of the middle loop. The third loop of the mid-gut is wide, and along it the cæca run in the fashion characteristic of birds in which these are functional; where the duodenum lay over this third loop, a bridging vein ran from the cæca to the duodenal branch of the mesenteric vein. The rectum is very long and is thrown into secondary folds.

It is obvious that the gut of *Opisthocomus* exhibits a definite divergence of a simple nature from what I tried to show, in the paper referred to above, to be the primitive type of avian intestines. The chief character of the typical intestinal folds is that the mid-gut, from the duodenum to the insertion of the long cæca, is a simple loop, thrown into short folds at the circumference of an almost circular expansion of the mesentery, and bearing near its median point a vestige of the yolk-sac. Such a condition occurs almost unmodified in the Struthious birds, in the Gallidæ and Cracidæ, and, among aquintocubital birds, in *Chama* and *Palamedea*, in *Himantopus*, *Glareola*, and *Caprimulgus*. So far as I have had opportunity of examining them, and I have now more than doubled the material upon which I first formed the conclusion, nearly every group of birds contains members approaching this primitive type. The divergences consist in the stretching out and twisting of secondary loops of this primitive circular loop, while the direction of the divergences is, on the whole, identical in each group. *Opisthocomus*, inasmuch as its mid-gut displays differentiation into three well-marked subsidiary loops, has advanced beyond the Gallidæ, Cracidæ, and Struthious birds. Its mode of divergence differs from that of the Tinamou, in which the first and third subsidiary loops are very long, but in which the region bearing the yolk-sac vestige and corresponding to the median loop is not expanded. Neglecting the fact that *Pterocles* and the Pigeons are aquintocubital, while *Opisthocomus* is certainly quincubital, the latter from the form of the gut is intermediate between *Pterocles* and the Pigeons. In these three the mid-gut has three loops, the central loop bearing the yolk-sac vestige: as in *Pterocles* the cæca are long; the middle loop shows a trace of the spiral formation which is characteristic of the higher Pigeons. Among quincubital birds *Opisthocomus* shows the closest resemblance to the Cuculidæ, in which also the cæca are long and the mid-gut is thrown into three loops, the median loop bearing the yolk-sac vestige. So far as argument may be based upon the formation of the mid-gut, either Huxley's<sup>1</sup> suggested relationship between

<sup>1</sup> "On the Classification and Distribution of the Alcedoromorphæ and Heteromorphæ," P. Z. S. 1868, p. 294.

*Opisthocomus*, Fowls, and Pigeons, and Garrod's<sup>1</sup> suggested relationship with Fowls and Cuckoos, is borne out. But the Gallinaceous birds are more primitive in the character of their mid-gut, and from this point of view *Opisthocomus* must be regarded as less primitive than them, while both Huxley and Garrod from other considerations regard it as more primitive.

The subsidiary looping and consequent length of the rectum or large intestine between the insertion of the cæca and the cloaca is a striking feature found only in few birds, all of which have the intestines otherwise primitive: it reaches a maximum in the Ostrich, giving the intestine of that bird a curiously mammalian aspect; it is absent in *Casuarus*, *Dromæus*, *Apteryx*, and *Rhynchotus*; it is well-marked in *Rhea*, *Chauna*, *Palamedea*, and in *Opisthocomus*. I am unable to correlate it with any degree of development of the cæca or with habits or food.

#### *Muscles of the Visceral Skeletal Apparatus.*

Although many papers have been written which include myological descriptions of *Opisthocomus*, I can find no account of the muscles of the jaws and hyoid. In a large number of birds the hyoid muscles in particular are difficult to isolate and dissect; many of them are extremely delicate, and the fasciæ of adjacent muscles blend with each other at many points. In *Opisthocomus* these muscles are particularly stout and free from each other; on removal of the skin covering the space between the mandibles they may be dissected out (see fig. 2, p. 622) with great ease.

*Mylohyoid anterior.*—This pair of muscles forms a broad transverse band stretching between the inner edges of the rami of the mandible. The fibres from the opposite sides pass straight across, not meeting in a median raphe as occurs in *Chauna* and the Goose; but the muscle is not, as in *Palamedea* and the Goose, divided into an anterior and posterior portion. It is much stouter than in a typical Pheasant like *Lophophorus impeyanus*.

*Mandibular Glands.*—Behind the symphysis, and with their proximal border just covered by the mylohyoid anterior, lie a pair of large ovoid glands, opening, as in the similar glands of *Chauna*<sup>2</sup>, by a number of small apertures into the floor of the mouth, where the mucous membrane reaches the horny edge of the lower jaw. In the Pheasant (*Lophophorus*) these glands are very large and lobulated.

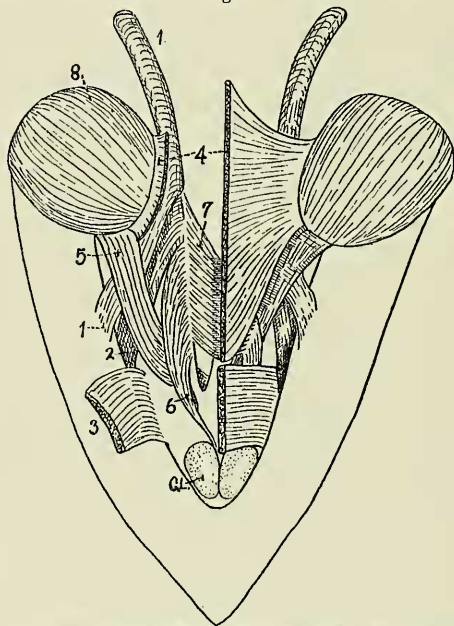
*Mylohyoid posterior.*—This, as in all birds that I have examined, or of which I can find record on the point, is a large muscle dividing almost immediately into an anterior deeper layer and a posterior more superficial layer. In *Opisthocomus* there is a large common origin from the outer side of the ramus of the jaw, immediately anterior to the insertion of the *depressor* muscle. From this comes the whole of the posterior, more superficial division of the

<sup>1</sup> "On the Anatomy of the Hoatzin," P. Z. S. 1879, p. 109.

<sup>2</sup> "Anatomy of *Chauna chavaria*," P. Z. S. 1895, p. 350.

muscle, which spreads anteriorly and posteriorly over the lower surface of the space between the jaws, reaching forwards nearly to the posterior border of the *mylohyoid anterior*, and meeting its fellow from the other side in the middle line. The anterior or deeper division of the *mylohyoid posterior* has its origin partly in

Fig. 2.

Dissection of hyoidean muscles of *Opisthocomus cristatus*.

1. Geniohyoid, posterior division. 2. Geniohyoid, anterior division. 3. Mylohyoid anterior. 4. Mylohyoid posterior, posterior division. 5. Mylohyoid posterior, anterior division. 6. Ceratoglossus. 7. Ceratohyoid. 8. Depressor mandibulae. Gl., Mandibular gland.

common with the foregoing division, but also extending a considerable distance over the inner surface of the ramus, a condition that I have not found in any other bird. In the Pheasants the origin is normal, a narrow nearly vertical line in front of the *depressor mandibulae* attachment.

*Geniohyoid*.—This muscle is in two distinct portions. The posterior division arises from the outer side of the ramus of the jaw, behind the anterior mylohyoid; it passes dorsally to both divisions of the posterior mylohyoid, and, running inwards and backwards, wraps round the ceratohyal to the tip. The anterior portion arises from the inner side of the ramus of the jaw, its edge being superficial to the *mylohyoid anterior*; it then runs forwards and inwards alongside the posterior division of this muscle, and is inserted to the ceratohyal, partly under and partly distally to the insertion of the posterior division. Gadow ('Das Thierreich,' p. 313) states that the *geniohyoid* is double in *Nectarinia*, *Otis*, Parrots, and *Rhea*; single in *Corvus*, *Anser*, *Procellaria*, and *Spheniscus*. Beddard and I found it single in *Palamedea*; I myself have found it single in *Chauna*, *Rhytidoceros*, *Cygnus*, *Pelecanus*, and *Lophophorus*; double in *Struthio*, *Dromæus*, *Rhea*, *Rhynchotus*, and *Ciconia*. It appears as if this muscle were comparable with the *latissimus dorsi*; originally a diffused sheet it tends to break up into two discrete bands, but there are not sufficient data to draw any inferences of taxonomic value from its double condition in *Opisthocomus*. The researches of Garrod showed that, in the case of certain notable thigh-muscles, completeness of muscle formulæ was, on the whole, primitive, while incompleteness was secondary. In the attempt to extend this view to other muscles it is necessary to remember that many muscles are in process of splitting, and that in these cases increase in number is a sign, not of primitive, but of derivative character.

*Genioglossus*.—At the most this is represented by a few fibres.

*Ceratoglossus*.—This is a very strong muscle, arising from the outer side of the ceratohyal, anterior to the *geniohyoids*; it passes forwards, superficially to the anterior division of the *mylohyoid posterior*, and deeply as regards the *mylohyoid anterior*; ending in a round tendon, it is inserted along the side of the tongue almost to the tip. There is no trace of the division into two, which occurs in Fowls.

*Ceratohyoid*.—This is a strong wide muscle running from the inner side of the ceratohyal, opposite the insertion of the foregoing muscle to the urohyal.

The *hypoglossals* and the system of the *sterno-hyoid* were present, but the individual muscles were not segmented from each other.

*Depressor mandibulæ*.—A single very large muscle, of which the internal portion is more tendinous, runs from the lateral posterior and under surface of the occiput to the posterior and ventral part of the lower jaw. In Ducks and Geese this muscle is represented by three distinct portions, all of which Beddard and I found in *Palamedea*<sup>1</sup>, and described as *biventer* and *digastric*. In the Fowls there are at least two portions separable; in *Opisthocomus* the tendinous inner portion no doubt represents an inner portion,

<sup>1</sup> "On the Anatomy of *Palamedea cornuta*," P. Z. S. 1894, p. 536.

which is separate and muscular in *Palamedea*, separate and tendinous in *Gallus*.

*Temporalis*.—The superficial portion of this muscle is very large and inseparable into layers; it arises from the whole temporal fossa, and from the external and internal surfaces of the mid-temporal process; it runs forwards and downwards under the quadrato-maxillary bar to the outer upper surface of the lower jaw; internal to this, and arising from the deeper region of the temporal fossa, is a strongly marked pyramidal muscle, which ends in a stout tendon inserted to the inner surface of the lower jaw. A still deeper portion runs across from the forward process of the quadrate to the inner side of the ramus. Lastly, a wide band of muscle bridges the narrow interval between the inner edge of the forward process of the quadrate and the wall of the orbit behind the optic foramen.

*Pterygoid*.—A superficial portion, similar to that found in Ducks and Geese runs from the ventral, posterior end of the lower jaw to the palatal membrane. It is not so tendinous as in the Ducks and Geese. The deeper portion of the pterygoid is an almost continuous mass of muscle, inseparable into regions, from the pterygo-palatine area to the lower jaw.

#### MUSCLES OF THE LEG.

##### *Variations in the Conditions of the Ambiens.*

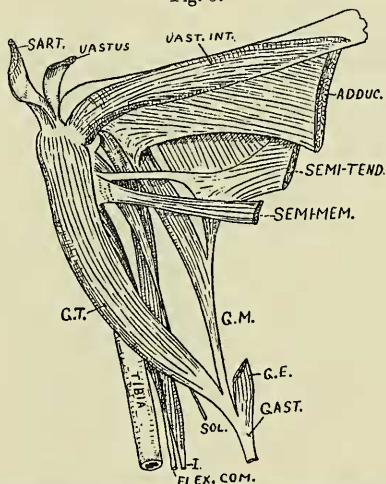
In the musculature of the leg there are several points (illustrated by figure 3, p. 625, and figure 4, p. 626) to which I wish to refer. As Garrod showed, the four muscles which he called A, B, X, and Y, the femoro-caudal and its accessory, the semitendinosus and its accessory, are all present. The interconnections between the muscles at the back of the knee differ so in birds that a description of their exact condition in *Opisthocomus* may be placed on record, although I have not yet sufficient material to make comparisons of any value.

The *adductors* have no insertion to the tibia, but send a strong slip to the middle head of the gastrocnemius. The semimembranosus, the most posterior of the thigh-muscles, runs straight in to the tibia, unconnected with the tendon of the semitendinosus. The accessory semitendinosus is very broad and strong, but does not nearly reach the tibia, being separated from that by the middle head of the gastrocnemius. The semitendinosus, after being joined by its accessory, sends in one fibrous slip to the tibia, proximal to that of the semimembranosus; while the greater mass of the muscle ends in a strong tendon, which runs down alongside and soon fuses with the middle head of the gastrocnemius, before that reaches the tibial head.

The condition of the *ambiens* muscle is still more interesting. Garrod (see paper referred to above) examined the legs of three specimens of *Opisthocomus*. In all cases he found the *ambiens* small, but normal, above the thigh. In five of the six legs it was

lost in the tendon over the knee, through which, in the normal condition, it passes. I dissected carefully for the *ambiens* in each leg of two of my specimens. In one case the *ambiens* was completely absent above the knee, and there was no trace of its tendon in the fasciæ and tendon over the knee. But in each of these legs (as shown in fig. 4, p. 626) a strong round ligament left the fibula, in the position in which the *ambiens* tendon of a bird with a normal *ambiens* crosses the fibula. This tendon passed down and sent a branch to each of the three perforated *flexors* of the

Fig. 3.

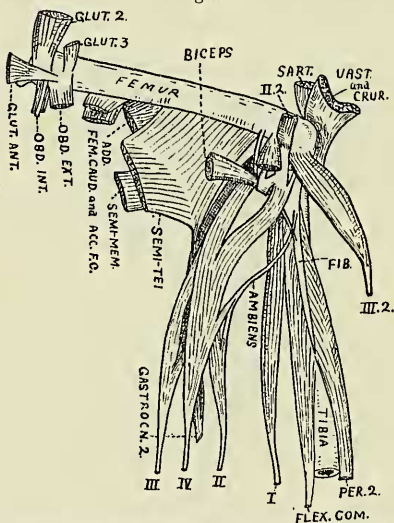
Thigh-muscles of *Opisthocomus cristatus*; posterior view.

*Sart.*, Sartorius. *Vast.int.*, Vastus internus. *Adduc.*, Adductors. *Semitend.*, Semitendinosus. *Semimem.*, Semimembranosus. *G.t.*, Gastrocnemius, tibial head. *G.m.*, Gastrocnemius, middle head. *G.e.*, Gastrocnemius, external head. *Sol.*, Soleus. *Flex.com.*, Flexor communis digitorum, I. Flexor longus hallucis.

digits. In a second specimen I found the *ambiens* above the knee. The tendon was lost at the knee-joint, but a rudiment slightly different from that in the first case was present in each leg below the knee. From the fibula, immediately distal to the attachment of the *biceps* tendon, three fibrous slips passed respectively to the perforated flexor muscle for the second, third, and fourth digits. It is well known that Garrod regarded the

presence or absence of the *ambiens* muscle as of primary importance. He divided birds into the Homalagonatæ, which possess the muscle, and the Anomalagonatæ, in which it is absent. Here and there among groups which certainly must be associated with the Homalagonatous birds there are instances in which the *ambiens* is absent, and in which Garrod believed the *ambiens* to have been present, but recently lost. It is of great interest therefore to

Fig. 4.



Leg-muscles of *Opisthocomus cristatus* showing vestigial *ambiens*.

*Glut. 2.* Attachment of gluteus medius. *Glut. 3.* Attachment of gluteus tertius. *Glut. ant.*, Gluteus anterior. *II. 2.* Flexor perforans et perforatus indicis. *III. 2.* Flexor perforans et perforatus medii. *Per. 2.* Peroneus secundus. *I.* Flexor longus hallucis. *II.* Flexor perforatus indicis. *III.* Flexor perforatus medii. *IV.* Flexor perforatus quarti.

find a species different individuals of which show so great variations in the condition of the *ambiens* muscle, reaching from the normal complete condition found by Garrod to the extremely vestigial condition in the specimen from which fig. 4 was drawn. Some time ago, in a paper communicated to this Society<sup>1</sup>, I recorded the discovery of vestiges of the *ambiens* in the case of two

<sup>1</sup> "On the Perforated Flexor Muscles in some Birds," P. Z. S. 1894, p. 495.

birds which, although they are certainly to be placed among the Homalognatæ and have close allies in which the *ambiens* is normal, are themselves without it. In *Nycticorax gardeni* the *ambiens* is absent; but in two specimens that I have dissected I found a slip to the flexor muscles from the fibula, similar to that in the *Opisthocomus* here figured, although it arose rather lower down the fibula. In *Eclectus roratus*, which again is devoid of an *ambiens*, although many Parrots are provided with it, I found a vestige almost precisely similar to that present in my second specimen of *Opisthocomus*, in which the *ambiens* ended on the knee. The vestige in *Eclectus*, as in the second *Opisthocomus*, consisted of three slips from the fibula to the flexor tendons. This additional evidence appears to me to strengthen the case for the taxonomic value of the *ambiens* considerably. While there were known only the rudiments described by me in *Eclectus* and *Nycticorax*, it might have been open to doubt whether or no these really were vestiges of an *ambiens*. Now that there have been found in different individuals of *Opisthocomus* graded vestiges linking my rudimentary condition with a complete *ambiens*, there seems no room to doubt that some, at least, of the Homalognatous birds devoid of an *ambiens* have once possessed it. On the other hand, I may mention that although *Dissura* is a Stork without an *ambiens*, while other genera of Storks possess it, in two specimens of *Dissura episcopus* I have recently dissected I could find no trace of the vestige.

Apart from possible systematic value, it is of interest to find variations of so great magnitude in a few specimens of a bird. Prof. Weldon has recently shown, after examination of an exceedingly large number of individuals of the shore-crabs, that very slight deviations may be associated with a larger death-rate. In the case of creatures so difficult to shoot as is *Opisthocomus* it may be the case that those actually examined have, from the greater magnitude of their variations, been less able to escape.

In conclusion, I may place on record three minor points in the myology of *Opisthocomus*, the only remaining features which seemed to me worth recording at the present time.

*Tendons of the perforated and of the perforated and perforating flexors of the third digit.*—In most birds the tendons of these are connected by a short stout vinculum immediately before they reach the foot. Gadow mentions that this occurs in Ratites, Fowls, and in *Pterocles*. I can add to this a very long list of birds, including *Rhynchotus*, *Chauna* and *Palamedea*, *Balearica*, *Psophia*, and *Fulica*. The slip is absent in *Opisthocomus*; the only other cases that I remember in which this occurs are *Asio otus* and *Rhytidoceros plicatus*.

*Short flexors from the deep plantar tendons.*—The tendon of the flexor longus hallucis is connected with the tendon of the flexor perforans by a strong vinculum and then supplies the thumb. A strong muscular slip, certainly absent in most birds, leaves the longus hallucis tendon immediately distal to the vinculum and runs to the fourth digit. A similar muscular slip leaves the tendon of

the *flexor perforans* and runs to the third digit. These slips are in addition to the ordinary short flexors, and it is possible that they throw light upon the origin of the very peculiar modes of distribution of the hallucis tendon in some groups of birds, as it has been repeatedly shown that a tendon may be the homologue of a muscle.

*Entepicondylulo-ularis*.—This muscle, which according to Gadow is present only in Rasores and in the Tinamou, is absent in *Opisthocomus*. This is another of the innumerable points separating *Opisthocomus* from Fowls.

2. On the Occurrence of Schlegel's Gavial (*Tomistoma schlegelii*) in the Malay Peninsula, with Remarks on the Atlas and Axis of the Crocodilians. By G. A. BOULENGER, F.R.S.

[Received May 29, 1896.]

A Gharial-like Crocodile, *Tomistoma schlegelii*, described by Salomon Müller in 1838, was, until lately, believed to be peculiar to Borneo. In 1890, however, its occurrence in Sumatra was recorded by Max Weber (Zool. Ergebn. p. 176). The Malay Peninsula may now be added to its habitat.

A few months ago, the British Museum received, from Mr. L. Wray, Curator of the Perak Government Museum, a fine half-grown specimen, with the following remarks:—

"The specimen was caught at Pulau Tiga, in the Perak river, in June 1895, and I kept it in a pond until the end of December, when it was killed. For months it would eat nothing but a few small fish, but during the later portion of the time it would eat freely of any meat or fish given to it. It also became quite tame and would remain at the surface of the water with its head on the bank while people stood near it.

"So far as I have been able to ascertain, no Crocodile belonging to the Gavial group has ever been recorded from the Malayan Peninsula, so that the following particulars will be of interest.

"I first heard of the occurrence of a Gavial in the State of Perak in 1889, and in the same year Mr. Cecil Wray, the then Acting Superintendent of Lower Perak, obtained a skull from the Perak river, and sent it to the Perak Museum; the animal was 7 feet long. A second was caught in the Kinta river, near Batu Gajah, in 1893 or 1894. It was secured by Capt. H. C. Metcalfe, of the Perak Sikhs, and the skin is now in his possession. It measures 6 feet 8 inches, but the tail is very short, having probably been injured when young; the head measures 18 inches, the upper jaw 30 inches, and the lower jaw 23 inches. A third was taken from the Batang Padang river near Tapah, and was seen by Mr. Page, the Inspector of Police at Tapah. It was